Marine Physical Laboratory

Downsloe Conversion

W. S. Hodgkiss

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William S. Hodgkiss

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Abstract

Carefully controlled and well-documented measurements of downslope signal propagation were made in an ONR-sponsored experiment in July 1989. Analysis of these data along with range-dependent propagation model predictions shows that both downslope conversion and range-variation of the sound speed structure are important propagation mechanisms coupling coastal shipping traffic noise into the sound channel

Research Objective

The objective of this project was to study the physics of downslope propagation which has been proposed as one mechanism by which acoustic energy from surface sources (e.g. shipping traffic) gets coupled into the sound channel.

Research Summary

Downslope conversion of noise originating from coastal shipping traffic has been discussed as being a major contributor to the low-angle noise distribution in the vertical plane (angles close to the horizontal). Another major mechanism discussed in the literature is high-latitude wind noise ducted into the sound channel due to shoaling of the sound axis.

Carefully controlled and well-documented measurements of downslope signal propagation were made in an ONR-sponsored experiment in July 1989. These included source deployments (both stations and tows) made in deep water, on the continental shelf, and along the sloping continental margin. For the purpose of propagation modeling, a substantial amount of environmental data was collected including: (1) both time and range-varying sound speed profiles between source and receiving arrays, (2) bottom topography, and (3) subbottom structure. Acoustic data was recorded on two vertical arrays - one on the edge of the continental slope and one out in deep water.

Analysis of these data along with range-dependent propagation model predictions shows that both downslope conversion and range-variation of the sound speed structure are important propagation mechanisms coupling NE Pacific coastal shipping traffic noise into the sound channel.

For sources within a few hundred km of the deep water array, the vertical arrival structure has little low-angle energy. This observation is explained by a simple application of Snell's law for surface grazing rays in a range-independent environment. Source transmissions over the continental slope yield a substantial low-angle of arrival component at the deep water array which is a manifestation of downslope conversion. Arrival structure similar to the continental slope transmissions also is seen from deep water transmissions not far from the continental slope. This vertical arrival structure can be modeled and is due to the range-variation of the sound speed structure between the deep water array and the continental slope. Thus, both downslope conversion and range-variation of the sound speed structure are important propagation mechanisms. These results are documented in [1-3].

Another area of interest in this work has been the manifestation of downslope converted continental shelf noise sources in the matched-field processor (MFP) ambiguity surface. Matched-field processing takes advantage of the complexity of the signal field observed with a large-aperture array of sensors in a waveguide to provide estimates of both source range and depth. Range-dependent Parabolic Equation (PE) simulations based on the July 1989 data set were carried out to investigate how noise sources outside the range of interest leak into the ambiguity surface through the sidelobe structure of the effective MFP beam (or cell) pattern. These simulations show that shallow sources on the continental slope appear in the MFP ambiguity surface as deep peaks when downslope conversion takes place. These results are documented in [4-5]

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